What I claim is:

1. In an ion implantation apparatus including a source for the generation of charged particles as an ion beam, a scanner which deflects the ion beam through a varying angle to yield a scanned ribbon beam, and a plane surface for the implantation of charged particles in the scanned ion beam into a workpiece which is moved through the scanned beam, the improvement of a fine-control collimator/steerer for accurate collimation and alignment of scanned beams, said fine-control collimator/steerer being comprised of:

first and second multideflector sequence arrangements symmetrically encompassing the width of the scanned ribbon beam, wherein each said multideflector sequence arrangement comprises

(1) a linear support bar comprising ferromagnetic material and having a fixed length and girth, and

(2) at least two coil deflectors wound independently and positioned adjacently at pre-chosen sites on said support bar, each of said coil deflectors being formed of electrically conductive wire and being wound to lie orthogonally to said support bar, and

(3) at least a pair of steering coils wound independently and positioned individually at each end of said support bar;

first on-demand controls for passing electrical energy of variable current independently and concurrently through each adjacently positioned coil deflector on each of said support bar of said first and second multideflector sequence arrangements, whereby

a. each adjacently positioned coil deflector becomes energized,

b. each energized coil deflector independently generates an adjustable local magnetic potential gradient of limited breadth and a magnetic field extending orthogonally between said linear support bars,

c. a plurality of said magnetic potential gradients of limited breadth concurrently and collectively form a contiguous magnetic field orthogonally extending between said first and second multideflector sequence arrangements, and

d. each adjustable local magnetic potential gradient within said contiguous magnetic field can be individually and concurrently altered at will to yield a pre-selected magnetic field gradient profile which extends over the linear length of said support bars;

second on-demand controls for passing electrical energy of variable current independently and concurrently through each said steering coil positioned at the ends of each said support bar whereby said steering coils become energized and generate an orthogonally extending magnetic field of limited breadth and an adjustable local magnetic potential gradient at each end of said linear support bar;

a spatial channel bounded by said multideflector sequence arrangements for applying a contiguous magnetic field and a pre-selected magnetic field gradient profile to a scanned ion beam traveling therethrough, wherein the parallelism for a scanned ion beam becomes finely controlled and more accurate.

2. The fine-control collimator/steerer as recited by claim 1 wherein the ion implantation apparatus includes a coarse collimator.

3. The fine-control collimator/steerer as recited by claim 1 wherein said independently wound and adjacently positioned coil deflectors on said support bar are between four and thirty in number.

4. The fine-control collimator/steerer as recited in claim1 further comprising:

electrical apparatus for supplying a programmable electric current independently to each coil deflector on said first multideflector sequence arrangement; and

electrical apparatus for supplying an equal and opposite current independently to each coil deflector on said second multideflector sequence arrangement.

5. The fine-control collimator/steerer as recited in claim1 further comprising electrical apparatus for superimposing a constant electric current in the same direction to all said coil deflectors sufficient to deflect a scanned ion beam in a measurable degree.

6. The fine-control collimator/steerer as recited in claim 1 further comprising:

a thin-layer wire wrapping wound over the linear length of each said support bar; and

means of applying an identical current in the same orientation to each said thin-layer wire wrapping effective to generate a constant magnetic field over the linear length of each support bar and deflect a scanned ion beam in measurable degree.

7. The fine-control collimator/steerer as recited in claim 1 further comprising apparatus suitable for measuring the instantaneous angular deviation ion beam relative to a reference axis at a plurality of points, such measurements being made in at least one direction orthogonal to the reference axis, and by which the electrical currents in said coil deflectors are adjusted responsive

to the measured angular deviations and reduce the deviation of the ion beam from the reference axis

8. A method of improving ion beam collimation in a hybrid-scan ion implantation system which includes an ion source, an analyzer magnet, a beam scanner scanning the beam within a plane, a coarse collimation device for converting the scanned beam into an approximately- parallel scanned ribbon beam, and a mechanism for passing a workpiece through the scanned ribbon beam at a target plane in a direction generally orthogonal to the direction the beam is scanned and implanting a substantially uniform dose of ions into the workpiece held at that plane , said improved collimation method comprising the steps of:

defining a reference axis of parallelism in a known orientation relative to the plane at which the workpiece is to be implanted with a dose of ions;

measuring the error in the direction of the beam centroid with respect to said reference axis within the plane at which the beam is scanned;

generating a controllable region of magnetic field and an adjustable magnetic field gradient profile in a direction substantially orthogonal to the plane at which the beam is scanned; and

adjusting the magnetic field gradient profile in response to said error measurement of beam centroid direction; and

applying said adjusted magnetic field gradient profile across the breadth of the beam such that said errors in the direction of the beam centroid are substantially eliminated relative to the plane at which the workpiece is to be implanted.

9. The method as recited in claim 8 further comprising the steps of:

measuring the component of motion of the beam centroid orthogonal to the plane within which the beam is scanned; and

providing a region in which there is a uniform component of magnetic field transverse to the beam and lying in the plane of the scan whose magnitude and direction are controlled, whereby the measured component of motion of the beam centroid in the y- axis direction is substantially eliminated.

10. The method as recited in claim 8 or 9 further comprising the steps of:

measuring the profile in the direction in which the beam is scanned of the dose rate provided by the ion beam; and

modifying the scan waveform to adjust the beam scan velocity , whereby the uniformity of the dosing of the workpiece with the ions in the beam is improved.

11. The method as recited in claim 8 or 9 wherein the coarse collimation device is a dipole magnet comprising pole pieces which are shaped in a manner that substantially eliminates that ion optical aberration which causes a variation in the spread of angles about the beam centroid as a function of the beam position within its scanned envelope.

12. The method as recited in claim 8 or 9 further comprising providing an additional controllable region of magnetic field at an upstream location, whereby the gradient of the magnetic field is caused to vary as a function of position in a manner which reduces residual high-order aberrations.

13. The method as recited in claim 8 wherein said controllable region of magnetic field is created by means of two sequential arrangements of coil deflectors, one on each side of the plane in which the beam is scanned, which extend orthogonal to the beam and lie parallel to the direction in which the beam is scanned.

14. The method as recited in claim 8 wherein said controllable region of magnetic field is created by means of movable pole pieces within a dipole magnet used to collimate the scanned ion beam.

15. The method as recited in claim 8 or 9 wherein said controllable region of magnetic field is created by using a fine-control collimator/steerer.

16. A method of improving the beam collimation and uniformity in a hybrid-scan ion implanter which includes an ion source, an analyzer magnet, a beam scanner scanning the beam within a plane, a coarse collimation device for converting the scanned beam into an approximately parallel-scanned ribbon beam, and a mechanism for passing a plane workpiece through the scanned ribbon beam in a direction generally orthogonal to the direction the beam is scanned, thereby implanting a substantially uniform dose of ions into the workpiece, said method comprising the steps of

defining an axis in a known orientation to the workpiece to be implanted;

measuring the error in the direction of the beam centroid with respect to said axis both within the plane and orthogonal to the plane within which the beam is scanned;

providing a controllable region of magnetic field substantially orthogonal to the plane in which the beam is scanned;

adjusting the field to vary along the long dimension of the beam envelope in response to the measurement so as to substantially eliminate the errors in direction of the beam centroid, both within said plane and orthogonal to said plane;

measuring the profile in the dimension in which the beam is scanned of the dose rate provided by the ion beam; and

modifying the waveform with which the scanner scans the ion beam so as to modify said dose rate profile and to cause said dose rate profile to conform more closely with a desired profile.